COM 402 - Data Visualization: Milestone 2

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Initial website can be found **here**

1. Introduction & Goal

In recent years, the urgency to address environmental sustainability has intensified. Travel-related carbon emissions are one of the main contributors to global climate change. We aim to empower users with interactive tools that illustrate the environmental footprints of various transportation modes, currently focusing on flights and trains. Our project focuses on Europe, but there is potential for expansion to include additional transportation options and other regions in the future.

The primary goal of our project is to encourage optimal travel decisions by presenting data in a compelling, visually engaging manner. Through interactive maps, users can compare CO2 emissions across different transportation methods and visualize the most eco-friendly routes for their journeys. These tools are designed to prompt reflection on travel choices without being overly authoritative.

Furthermore, our visualizations aim to serve as an incentive for change, highlighting areas where transportation policies can be improved to support greener travel options. By doing this, we hope to encourage people and governments to adopt more sustainable travel practices.

2. Sketches - available in the Appendix

2.1 Map for comparing different means of transport from point A to B - Figure 1
Features: The main page of our website will contain a full-screen map of Europe, as shown in Figure 1. To the left of the screen, there will be a rectangular box that contains basic instructions and interactive components that let users choose between train and plane travel options. The user can use the search box to select departure and arrival cities. Depending on their selection, either flight or train route—or both—will appear. These routes will be marked with lines that are colored according to the amount of CO2 emissions. Details such as duration, CO2 emissions, and energy consumption will be displayed.
Goal: We consider this a fine-grained visualization, enabling the user freedom to explore and compare eco-friendly travel options on a city-to-city basis.

2.2 Map showcasing the top 3 destinations reachable by least CO2 - Figure 2
Features: This map lets users select a starting city and then highlights the top three destinations that can be reached while emitting the least CO2. For each highlighted route, we will also provide specific details such as travel time, energy consumption and CO2 emissions. The routes are color-coded according to their carbon footprint, visually informing users about the more sustainable, and often more **local**, travel options available.
Extra Features: Let the user choose the maximum travel distance and the number of cities they wish to explore (top K).
Goal: This visualization is designed to raise awareness of accessible destinations that contribute less to carbon emissions. In a way encouraging the user to consider local travel.

2.3 Circle layout graph - Figure 3

Features: In our third visualization, we present a circular layout graph where the nodes symbolize the cities available in our dataset and the edges represent the connections between these cities, if such connections exist. Each edge is weighted based on the average CO2 emissions associated with traveling that route.

Extra Features: If time permits, we plan to include a filter that allows users to scale up the graph to display connections by country or region, offering a coarser-grained view.

Goal: This visualization aims to illuminate regional and national travel patterns, emphasizing their contribution to overall carbon emissions. This visualization will serve as a transition from focusing on individual cities to broader insights at the country or regional level.

2.4 Map with matrix showcasing average emission when traveling between regions - Figure 4

Features: For our final visualization, we aim to showcase carbon emissions from inter-regional travel. On the left side of the page, a matrix will display the average CO2 emissions for all possible combinations of departure and arrival regions. The matrix elements will be color-coded based on the average CO2 emissions when traveling from region A to region B. Users will be able to hover over the matrix dots, and the corresponding regions will be highlighted on the map.

Extra Features: If time permits, we will draw a line from the average point of region A to the average point of region B. Upon 'arrival' at region B, we will extend paths to all nearest neighboring cities within specified distances (e.g., 100 km, 200 km), illustrating potential short-range explorations.

Goal: This visualization anticipates a shift in future travel behavior, emphasizing the need to balance efficient exploration with reduced carbon footprints, fundamentally changing how we manage travel.

3. Tools & Lectures

For the website we use the framework Angular hosted on Github Pages. Throughout the process of building the website we are guided by the following lectures: Basic web development, Javascript part 1, More Javascript, D3.js, Do and dont in viz, Designing viz, Mark and channels. For conveying the story we are mostly motivated by the lecture Storytelling. The lectures and tools we use per visualization are presented below in the table:

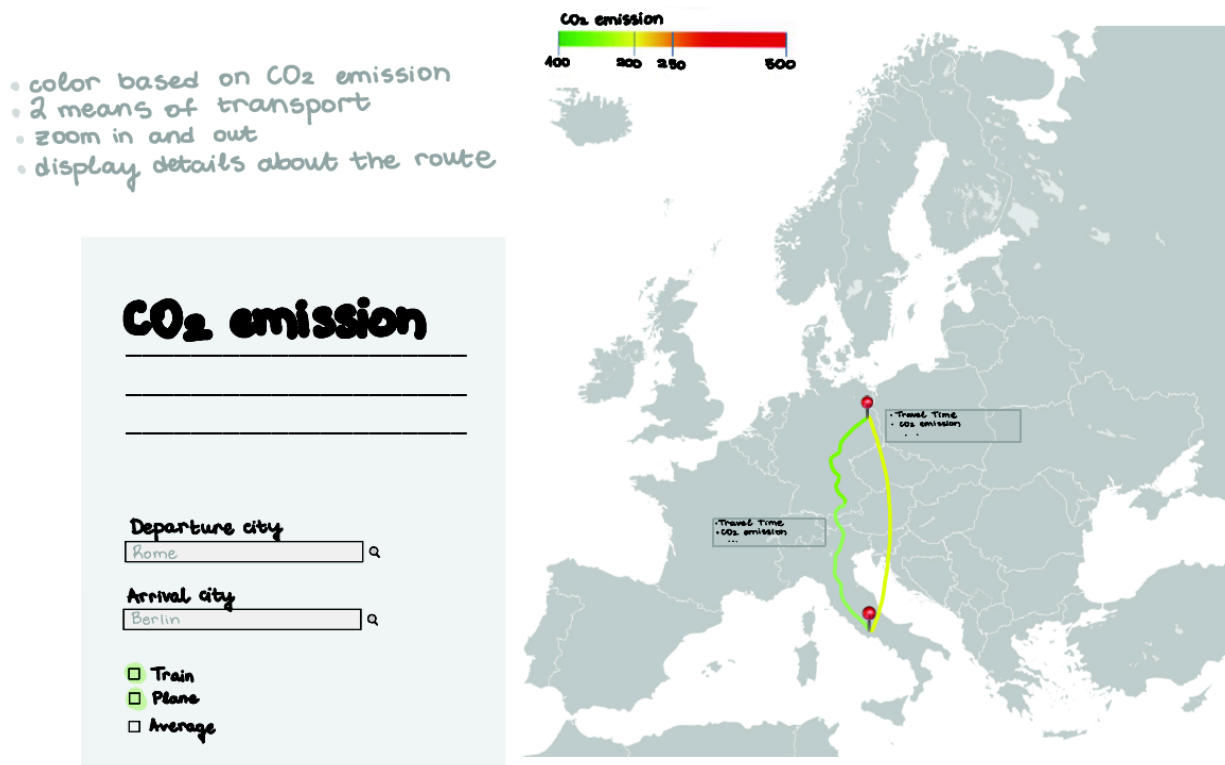| Visualization	Related Lectures	Tools
Map for comparing different means of transport from point A to B	Interactions, Perception colors, Practical Maps, Mark and channels	Leaflet + D3.js
Circle layout graph	Interactions, Graphs, Perception colors, Mark and channels	D3.js
Map showcasing the top 3 destinations reachable by least CO2	Maps, Practical Maps	Leaflet + D3.js
Map with matrix showcasing average emission when traveling from region A to region B	Interactions, Maps, Tabular Data, Practical Maps	Leaflet + D3.js

4. Appendix

- color based on CO₂ emission
- 2 means of transport
- zoom in and out
- display details about the route

CO₂ emission

400   200   250   500

CO₂ emission

_____
_____
_____

Departure city
Rome 🔍

Arrival city
Berlin 🔍

☑ Train
☑ Plane
☐ Average

- Travel Time
- CO₂ emission

- Travel Time
- CO₂ emission

Figure 1: Map for comparing different means of transport from point A to B

- list the routes emiting the least CO₂ from a starting city
- focuses on travelling locally

City Name,
Travel Time,
Avg. CO₂ emission

Search for a city
🔍

Top 3 destinations reachable by emitting least CO₂:

1.- - - - - - -
2.- - - - - - - - -
3.- - - -

Figure 2: Map showcasing the top 3 destinations reachable by least CO2
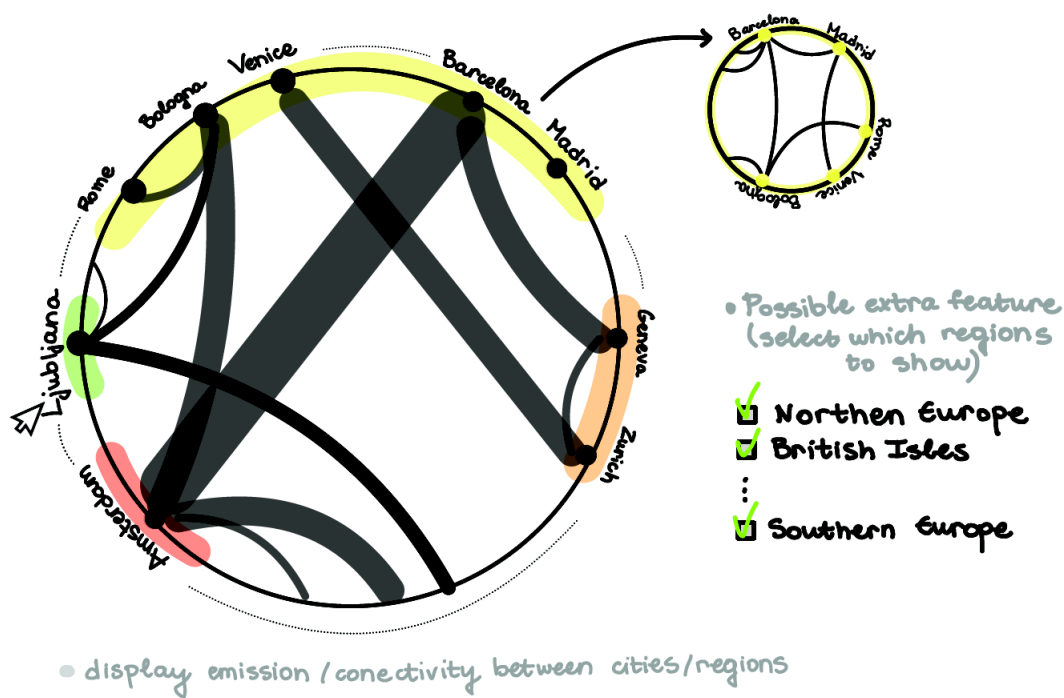
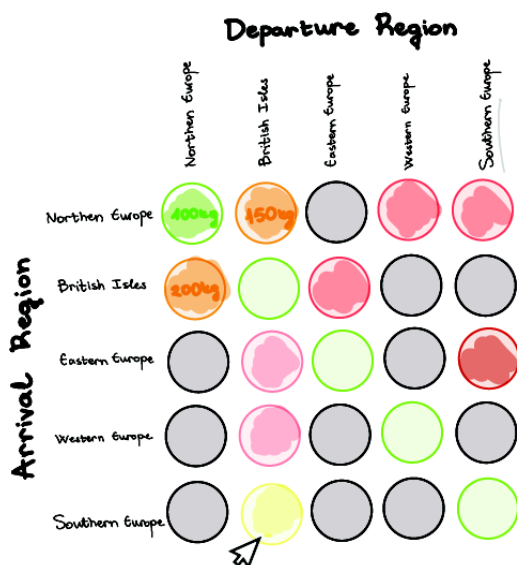*Figure 3: Circle layout graph*
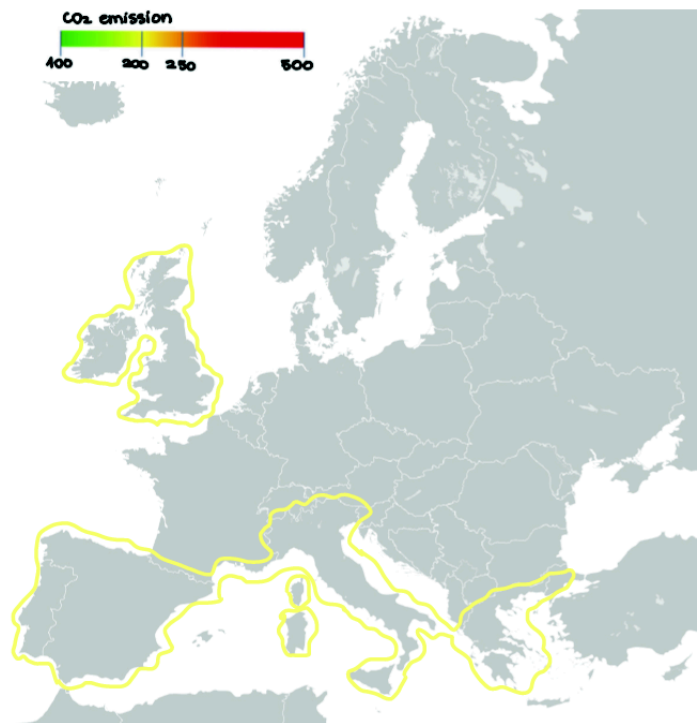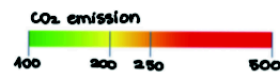
Figure 4: Map with matrix showcasing emission when traveling from region A to region B